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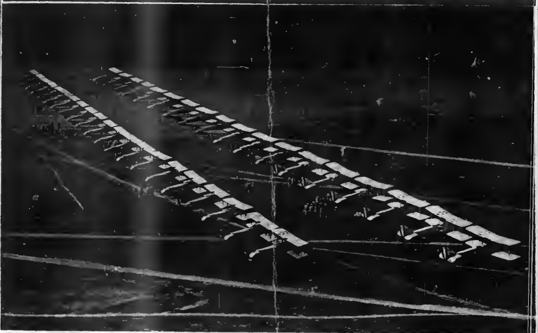

Naval Aircraft Squadrons at San Diego, California

VOLUME XIII

Number 26

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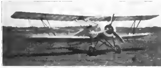

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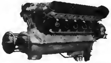

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AVIATION

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Vol XIII DECEMBER 25, 1922 No. 26

A National Aeronautic Policy

THE national aeronautic policy formulated by the National Advisory Committee for Aeronautics which received President Harding's endorsement when he sent that body's annual report to Congress deserves the active support of all concerned with the development of American aeronautics.

The need of a clearly cut national aeronautic policy is obvious. One of its chief points should in our opinion be a continuing aircraft construction program somewhat on the order of the Naval Defense Act of 1916 which laid down the number and type of warships to be built within a given period of years. An aircraft construction program drawn up along such lines would have the great advantage of insuring aircraft manufacturers continuing orders spread over a number of years. It is only on the basis of such a program that the manufacturers can shoulder the expense of engaging in new development work of any real magnitude, such as the development of large multi-engined airplanes, variable camber and variable surface wings, new methods of metal construction, etc.

There has been some tendency in official quarters to criticize the delays attendant the delivery of aircraft built by the industry. It should, however, be realized that a manufacturer cannot afford to expand his works for a single order, however large, and risk having his factory stay idle for months after the order has been filled and no new order is forthcoming

Another important point, which the N.A.C.A. program properly emphasizes, is the practical application of aviation to mail carrying, "one of the marvels of the age." The N.A.C.A. recommends the continuance of the Air Mail Service, but we would like to go further and see its operation considerably extended, particularly by the creation of a North to South route along the Mississippi.

The importance of scientific research in aviation will be obvious to those even but slightly connected with aeronautics. Hence the N.A.C.A. recommendation for ample funds wherewith to continue this work should meet with general approval.

Federal regulation of aeronautics, which AVIATION has actively sponsored ever since the Armistice—a matter of four years now—is another important point to which the N.A.C.A. calls attention. It is to be hoped that this latest reminder may perhaps shake the apathy of Congress with regard to the Wadsworth Bill

One of the best points in the N.A.C.A. program is the suggestion that in view of the growing importance of the aerial arm, the army and navy air forces should not be reduced in proportion to the reduction in strength of the Army and the Navy. Quoting the report, "the novelty of aerial warfare, the lack of civil aviation activities from which to draw in time of need, the rapid development of aeronautics in other countries, and the necessity for aviation in national defense, have led the people to support a policy of progress and development in aeronautic branches of both the Army and Navy, however much they may insist upon curtailment of other military expenditures."

The conservation of our helium resources, the development of extraction methods of this gas, and the development of the aerological service of the Weather Bureau are other excellent recommendations of the N.A.C.A.

What we should have liked to see incorporated in the National Aeronautic Policy is a definite program for the development of commercial aviation as a national asset and a public utility. With respect to this subject the report states among other things that "the practical development of aviation in America will be realized only when this government gives intelligent support and effective aid, principally by regulating and licensing airplanes and pilots and with state cooperation in establishing airways and landing fields." This is excellently put, but it would have been much stronger had a practical suggestion been made to illustrate the national asset of civil aviation, by suggesting a system of national airways to be built by the government, the states and municipalities.

Purchase of Materials in Airplane Construction

UNDOUBTEDLY one of the most important difficulties in the construction of airplanes is the purchase of suitable material. The materials called for by the designer in accordance with Navy or Army specifications are of the highest quality, generally of special characteristics, and rarely to be bought in the open market. The spruce to be used is of a better grade than in any other form of construction; it must be straighter, better seasoned, freer from defects than commercial lumber ever is. The steel is of a specification which is never carried in stock by steel mills or jobbers. The veneer is thinner than is generally the case in its varied commercial uses; it must stand exceptionally severe tests for waterproofing; it must be glued up in one particular way.

At the same time the manufacturer cannot purchase his materials in large quantities. If he could order a few thousand tons of a certain grade of steel, no doubt the mills would be glad to roll specially for him and to give him quick deliveries. But the airplane manufacturer considers four or five tons of his special steel quite a large order, and gets poor service accordingly. Only two or three manufacturers of veneer will quote on aircraft requirements at all

This situation would be best met if a number of firms in a position to supply aircraft material specialized as this business, making an exhaustive study of the needs of this industry and carrying material in stock as far as possible. Not only would firms thus specializing find a ready market at the moment, but they would be rewarded later when the industry expands to larger proportions by having almost a monopoly of aircraft material purchases.

Improvements in Built-Up Airship Girders

With Special Reference to the Strength of Girders As a Whole

By S. H. Phillips

The present article deals with the bracing of light structural or built-up girders, as used for example, in rigid airships, and has for its chief object, to reduce the weight and cost of labor charges of the lattice pieces employed to connect the longitudinal members or booms while providing for the necessary strength and rigidity.

Such lattice pieces as at present used, are made in suitable dies and presses from thin sheet metal, such as duralumin or steel, or the like. Two individual stamped lattices are taken crossed and riveted up at the centers. A typical lattice and arrangement of this nature is shown in Fig. 1, with their method of attachment at girder members, which represents the practice used at the present day.

No advance in the design or manufacture of lattices used in airship girder work can be recorded recently, nor apparently has any serious suggestion, to the writer's knowledge, ever been put forward, either to save weight or reduce labor charges. It is therefore sufficient to say, that precisely the same lattice arrangements are being used in the airships at present building as were incorporated in the Zeppelin designs of six or seven years ago. The writer proposes, in order to simplify manufacture and to gain increased efficiency, to stamp these crosses in one piece as shown in Fig. 2, thus eliminating the center palm.

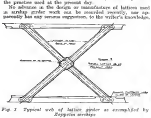


Fig. 1 Typical web of lattice girder as exemplified by Zeppelin airships

The advantages of using such a method can be stated briefly, as under:

1. No decrease in strength
2. Saving in weight.
3. Elimination of center palm rivets.
4. Elimination of the flattening of channels in way of lattice palms at their connection to these members with the exception where double lattices are required
5. Accelerated production.
6. Saving in labor costs

The disadvantages are slight when compared with the obvious many advantages, and can be stated as under:

1. Slightly more complicated stamping.
2. Larger percentage of scrap material over the existing method.

We can now proceed to examine and verify our statements.

1. No Decrease in Strength

It is considered that no decrease in strength will be lost by constructing cross in one piece, in place of two members as at present used. A faulty riveted up center palm is apt to set up initial strains. A slight distortion is set up in the lattices, due to the thickness of the channel members—in other words, they are sprung in at the center palm. None of these objections are met with in the new design.

The brief discussion on Zeppelin airship girders should be observed. Primarily, it should be noted that triangular girders of the Zeppelin type (see sketch Fig. 3) are principally used as struts, and in calculating the strength of such girders, the strength of the elements of the main members between the points of attachments, marked *B*, of adjacent lattice pieces, should first be considered.

The strength of these elements depends on the stiffness of the individual lattice pieces. If the bearings were infinitely stiff and were attached to the main members in an absolutely rigid manner, the pin jointed lengths of the element would be half the pitch of the lattices, but if the bracing is without stiffness or is pivoted to the main members, then the pin jointed length may be taken as equal to the pitch of the lattice. The exact effect of the stiffness of the bracing on the pin jointed length can readily be calculated, first by determining the rigidity of the lattice in the plane of the main members.

In the case of triangular girders of the Zeppelin type the main members are light, owing to the pitch of the lattice being very much greater compared with the radius of gyration of the main member. The chief requirement of the lattice is that it should be very stiff in the plane of the girder. Since Zeppelin type girders are used only as struts, the shear forces are light and the compressive strength of the lattice pieces themselves is relatively unimportant.

For these reasons the type of lattice piece which has been developed for airship girders is very broad, compressive strength being obtained merely by pressing it into a corrugated section. Furthermore it is always used in the form of a cross lattice, the opposing lattice pieces being well riveted together in the centers, the reason throughout being to obtain great stiffness in the plane of the girder. The writer believes that the type of lattice proposed would have the same stiffness as the ordinary type.

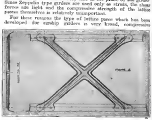


Fig. 2 New type of one-piece web for bracing built-up airship girders, as proposed by the author of this article

This arrangement has the effect of preventing entirely the light main members from deflecting at the points of attachment of the lattice and practically makes the small element of main members between lattice points a fixed end strut and hence, very greatly increases the strength and efficiency of the girder.

The strength of the main members may therefore be calculated on the assumption that they are pin jointed members half the pitch of the lattices in the following manner.

It has been found that the formula below, for strength of main spars as struts, calculated in the way above described, gives results closely in agreement with experiments.—

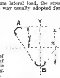
$$\frac{P}{A} = fa\left(\frac{1+B}{1+B+B^2}\right)$$

$$B = \frac{fa}{\pi^2 E}\left(\frac{1}{K}\right)^2$$

where P = the intensity of stress in lb. per sq. in. of failure.

For girders under uniform lateral load, the stress per sq. in. can be calculated in the way usually adopted for a loaded beam from the formula

$$P = \frac{My}{I} = \frac{M}{Z}$$



where $Z = \dfrac{I}{y}$

I = Moment of inertia of cross section of girder about neutral axis (which passes through c.g. of cross section of girder).

let $A.A$ = section area of base channels
B = sectional area of apex channel
let a = Dist. of c.g. of base channel from neutral axis
" b = Dist. of c.g. of apex channel from neutral axis
" X = Dist. of c.g. of apex channel from c.g. of base channel

This distance can be found from the known size of the girder

Then $a + b = X$

$2A \times a = b \times B$

$I = 2Aa^2 + Bb^2$ approx.

whence a, b and I can be found.

We can then obtain the values of Y/apex and Y/base the distance from neutral axis of the fibers in the apex and base channels which are under the greatest stress. If the loading is uniform and the beam freely supported, then the maximum bending moment in pounds inches is:

$M = \frac{1}{8}WL$

L = length of girder in inches.

W = load (total) in pounds.

Professor Thurston in his paper on Metal Construction of Aircraft, read before the Royal Aeronautical Society in 1919, gave the following formulae for deflection under lateral load.

From the ordinary theory of beams the deflection in the center of the girder under side loading is equal to

$$\delta = \frac{5}{48}\,\frac{L^2 M}{EI}$$

where δ is the deflection in inches.
L is the length between the supports in inches.
M is the maximum bending moment in inches.
I is the moment of inertia in inch units about an axis perpendicular to the direction of loading.
E is Young's modulus for the material of the girder which as a result of bending tests on girders is taken as 5500 tons per sq. in.

Since $\dfrac{M}{I} = \dfrac{2f}{L}$

where f is the limiting fiber stress and D is the total depth of a symmetrical section we have

$$\delta = \frac{5}{48}\,\frac{L^2}{5500}\,\frac{2f}{D} = \frac{1}{26400}\,\frac{fL^2}{D}$$

Now in the case of a long strut, if the direct stress is ignored, practically the same law should hold

Since $M = Pe \times 8 \quad \therefore Pe = \dfrac{M}{8}$

$$Pe = \frac{\pi^2 EI}{L^2}$$

$$\therefore \frac{M}{8} = \frac{\pi^2 EI}{L^2} \quad \therefore 8 = \frac{ML^2}{\pi^2 EI}$$

$$\frac{M}{I} = \frac{2f}{D} \quad \therefore \frac{2L^2 f}{\pi^2 ED} = \frac{2}{9.87 \times 5500}\,\frac{L^2 f}{D}$$

$$\therefore \delta = \frac{1}{27\,100}\,\frac{fL^2}{D}$$

The deflection calculated by the above means agree with the results of experiments very closely. Therefore, in designing beams to withstand combined stresses, the approximate deflection should be calculated by the formula

$$\delta = \frac{1}{26.400}\,\frac{fL^2}{D}$$

The rigidity of the lattice pieces can therefore be calculated on a known deflection of the main spar, by the use of either Perry's or the Alexander formulae.

It appears that the theoretical advantages of both types of lattices are the same. In the Zeppelin type of lattice it is usual practice to rivet consecutive lattice units separately, in such way that there is a row of four rivets, two attaching each lattice piece separately. In such cases, where the shear forces become too great to render failure between points of attachment of successive lattice pieces probable, the practice is to rivet on intermediate lattice crosses between the main lattices.

This type of construction gives a most efficient girder from the point of view of strength for weight in this particular case. In other words, in Zeppelin construction, it is usually entirely unnecessary to calculate shear in the lattices, but only in the main members. When however the main members are heavy as in aircraft spars, continuous bracing gives the best results and failure usually occurs by shear in the main members between lattice points.

In the case of airplane spars, since the main members are so much heavier, they would require a proportionally stiffer and heavier bracing to impress fixed ended conditions on the main member between bracing points. Furthermore, the overall depth of the spar is fixed and the angularity of the lattice pieces is limited by practical conditions. It is found in this case that the value of L/K between lattice points is comparatively small and the increase of strength gained by changing the condition of the main member between lattice points from a free ended to a fixed ended strut does not in any way justify the big increase in weight of lattices which would be necessitated. Zeppelin type of lattice in this case is, therefore, noeconomical, and for airplane spars experience has proved that no attempt should be made to obtain stiffness in the plane of the spar and the lattices should only be of sufficient strength to withstand the shear forces which may be calculated in the usual way, assuming that the lattice is pin jointed.

Furthermore, care should be taken that the line of intersection of adjacent lattice pieces occurs at such a point of the cross section of the main member as will ensure the most efficient distribution of stress over these members.

Having briefly discussed the theoretical points in airship girder design, it is the opinion of the writer that there cannot be any disadvantage in omitting the center rivets theoretically further, considerable practical advantages are obtained as discussed as follows —

2. Saving Weight

Saving of weight is effected in two directions:

1. Elimination of rivets at center

2. Avoidance of overlap at the center which occurs when two individual lattices are crossed.

It is interesting to observe that the net reduction of weight on a rigid airship of 2,000,000 cu. ft. capacity would be approximately 500 lb by the use of the lattices of the suggested type.

3. Elimination of Center Palm Rivets

Here the saving of labor cost is considerable, as the operation of riveting the lattices into crosses is entirely dispensed with, thus saving, i.e.

1. Cost of rivets.
2. Cost of jigs used in this operation
3. Inspection cost.
4. Labor charge in carrying out the operation.

It is estimated that in actual figures, the cost works out approximately as follows:

Cost of rivets for entire ship	$ 250 00
Cost of two jigs	200 00
Inspection	300 00
Labor charge	4200 00
Net saving	$4950 00

4 Elimination of Flattening Channels in Way of Lattice Palms

As it will be seen from the diagram of the proposed new type of lattice, the fitting is now stamped in one direction. This enables the lattice palms always to be fitted on the outside of the channel girder members, thus eliminating the

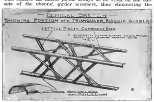


Fig. 3 Section of a typical built-up airship girder

necessary flattening where the lattice palms pass inside the channel flange, as in the old system. This is a strong advantage on the side of the new proposal, as it increases the girder efficiency and saves the labor cost of flattening, which, expressed in figures, for a ship of 2,000,000 cu ft capacity works out approximately $2400 00

5 Accelerated Production

The speeding up of production is obvious, as it reduces the time necessary for stamping lattices to about half that entailed by the present system. It will be realized that in place of two stampings forming the cross at present adopted, only one is now proposed

The estimated man-hours required to produce the entire lattices for the ship of the capacity as previously stated are approximately 7,000 hr This time is accordingly reduced to 3,500 hr., the cost proportionately reduced from $12,600 00 to $6,300.00.

6. Saving in Labor Costs

The saving in labor costs is affected in the following instances:

1. Elimination of center rivets.
2. Flattening of channels required.
3. Reduction in cost of stamping.

The net labor charges saved on the above three items can be stated below, based on airships of a capacity as previously mentioned

1.	$4850 00
2.	2400 00
3	6300 00
	$13,550 00

Total net saving in labor charges $13,550 00

The Disadvantages

Proceeding now to discuss the disadvantages which this proposal has, in the order already stated

Possibility of Stamping Operation Becoming more Complicated—This necessitates more delicate handling Where the fittings meet at the center, difficulty may be experienced in getting the material to run satisfactorily at this junction. However, it is not considered unsolvable

Larger Percentage of Scrap Material over the Existing Method—This is certainly the most serious objection to the new proposal, as the material lost in the stamping operation is very much increased over the old method.

The figures tabulated below, are sufficiently clear and need no explanation.

ITEM	Total weight of lattices in ship as at present used	Total weight estimated in new proposal
Weight of finished crosses required for entire ship of 2 000 000 cu ft. capacity	8061 pounds	7438 pounds
Weight of strip to manufacture same	10075 pounds	15918 pounds
Weight of scrap	2014 pounds	8482 pounds
Cost of material at $.75 per lb	$7556 00	$11938 00
Cost of scrap	1510.00	6360.00

The increased cost of material used is therefore $4382 00
This reduces the gain in labor charges of $13550 00 to $13 550.00 — $4382 00 — $9,168 00

Resuming, the reduction in cost and gain in useful load over a rigid airship of the Zeppelin class, can be stated as follows:

Labor cost $9,168 00
Gain in useful load .... 500 lb

Internal Stresses in Laminated Construction

N.A.C.A. Report No. 145

Report No 145 of the National Advisory Committee for Aeronautics, by A L Heim, A. C Knauss and Louis Seutter, reviews the procedure employed in an investigation of the sources and influence of internal stresses in laminated construction, and discusses the influence of shrinkage and swelling stresses caused by atmospheric conditions upon the tensile strength across grain in laminated construction with special reference to airplane propellers.

The investigation covered three sources of internal stress, namely, the combination of plain-sawed and quarter-sawed material in the same construction, the gluing together of laminations of different moisture contents, and the gluing together of laminations of different densities.

Glued specimens and free specimens, made up under various manufacturing conditions, were subjected to various climatic changes inducing internal stresses and then were tested. The strength of free unstressed pieces served as a standard of comparison for glued pieces and indicated what internal stresses were developed in the glued construction.

A copy of Report No. 145 may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D C

British Passenger Figures

2682 persons flew to and from London last August, an increase over the 2021 carried in Aug 1921. 82 per cent were carried by British companies, French and Dutch together, 18 per cent.

The Airplane and the Amateur Builder

A Compendium of Elementary Notions and Formulae For Building a Small Single-Seater Sport Plane

By Lester D. Seymour, E E., A.E.

Aerial navigation, like other newly developed means of transportation, is now the subject of thought and experiment throughout the country by hundreds of men and boys who are building and flying their own airplanes. To such builders and experimenters this article is directed, believing that in it will be found much to assist in their efforts and perhaps point out certain features on which could very easily depend the success or failure of their entire work.

A few years ago, the design of a small airplane was quite a different matter from that of today. Hundreds of these machines have been built, many of which have been successfully flown. The builder of today, then, if he attacks his work intelligently, should make use of these pioneer efforts, or in other words "begin where the other fellow left off" From the chart which is here reproduced, the main characteristics of some forty or more airplanes of less than 50 hp

Fig 1 U S Army "Messenger" (60 hp Lawrance engine)—a good example of clean and up-to-date design

may be studied From this same chart magazine references may be secured from which pictures and somewhat more detailed descriptions may in many cases be found.

Proceeding on the plan of making use of some one's else efforts, one very satisfactory method of making preliminary drawings is to examine carefully the relative dimensions of some machine that has been quite successful and then build similar or proportional characteristics into the new machine. Adaptation of a particular engine is not in this way difficult and one can be reasonably sure that his machine will perform satisfactorily

Method of Procedure

As an example, I have here shown the principal dimensions and outlines of the U. S. Army Air Service "Messenger," which because of its very excellent performance is worthy of examination and study This machine, it is true, uses an engine slightly larger than most of those on the chart but its characteristics, nevertheless, can be safely relied upon as applicable to the design of almost any small machine.

In general, following the above suggestion, the preliminary considerations in selecting dimensions, etc., for a small machine are as follows:

(a) Select the engine to be used.
(b) Assume a hp. per sq. ft. loading
(c) Assume a lb. per sq. ft loading.
(d) Calculate the total wing area.
(e) Select type of airplane (monoplane, biplane, triplane).
(f) Select an aspect ratio (ratio of span to chord).
(g) Determine size and placing of control and stabilizing surfaces.
(h) Make a preliminary drawing to scale embodying the rough dimensions determined upon.

Sample Calculations

Let us assume an air cooled engine, weighing 125 lb. and developing 30 hp at 1250 r.p.m is to be used.

From an examination of the chart and other existing data it appears that a power loading of 20 lb. per hp as a maximum, and a wing loading of 5 lb. per sq ft., has been successfully used. From this, then, it is seen that our total weight loaded, should not exceed 20 x 30, or 600 lb., and that the total supporting surface should not be less than 600/5, or 120 sq ft.

Assuming, now, that a biplane type is well suited for our purposes, we can divide our total surface (120 sq ft.) by 2 and so obtain the approximate area of each wing. A biplane is chosen in preference to a monoplane in order to keep overall dimensions as small as possible and at the same time secure the advantage of ease in bracing and additional strength and simplicity of the truss. Referring to the sketch of the "Messenger" and the chart, we see that an aspect ratio of 5 is not unreasonable.

Using this figure, our chord can be found in the following manner, knowing our area A and denoting the span by S and the chord by C.

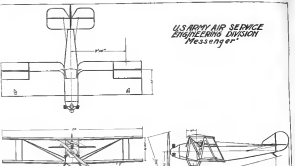
$$S/C = 5, \text{ and } S \times C = 60$$

$$\text{From the above } \frac{60}{C} = 5C, \text{ or } C = 3.47 \text{ ft. (use 3.5)}$$

Taking a chord of 3.5 ft. and an aspect ratio of 5 we see that our span will be 3.5 × 5, or 17.5 ft. The area now of each wing will be 17.5 × 3.5, or 61.2 sq ft. Our total supporting surface is then 61.2 × 2, or 122.4 sq ft.

Referring again to the "Messenger," we see that the distance of the tail surfaces (stern post) from the center of gravity of the machine is approximately 10.835 ft., or 10.835/4 times the chord, i.e., 2.71 times. Applying this figure to our machine we see that this distance will be 3.5 × 2.71, or 9.5 ft.

Inasmuch as this point (stern post) can be assumed to be the point at which the tail stabilizing and control surfaces act, we can assume that since we have made our lever arm distance (stern post to center of gravity) in the same ratio as that of the "Messenger," the area of our tail surfaces should be somewhere near the same relation to our total supporting area. For the "Messenger" these areas are:



Outline drawings of the U. S "Messenger" airplane (60 hp. Lawrance 3-cyl. air-cooled engine)

Stabilizer	— 11 sq. ft. = 7.24%	of 125 sq. ft. (total supporting area)
Elevators	— 10 sq. ft. = 6.58%	of 152 sq. ft. (total supporting area)
Rudder	— 5.75 sq. ft. = 3.78%	of 152 sq. ft. (total supporting area)
Fin	— 2.75 sq. ft. = 1.81%	of 152 sq. ft. (total supporting area)

Applying the above percentages, the areas of our tail surfaces will be approximately:

Stabilizer	— 0.0724 × 120*	= 8.18	sq. ft
Elevators	— 0.0658 × 120	= 7.91	" "
Rudder	— 0.0378 × 120	= 4.53	" "
Fin	— 0.0181 × 120	= 2.17	" "

*120 sq. ft. total area is used instead of 122.4 since undoubtedly structural considerations (fuselage for instance) will reduce our area slightly.

Aileron control surfaces should be our next consideration, and examining again the "Messenger" we see that on either pair of wings there is a total of 10 sq. ft. placed at a distance of 7.834 ft. from the longitudinal axis of the machine. The moment exerted is then a function of $F \times K$ where K = the area of the ailerons, and F = the distance from their center to the longitudinal axis of the machine. We will denote this value by M. $M = 7.834 \times 10 = 78.34$. Since we have used the same aspect ratio, it appears to be safe if we assume that $M_1/M = S_1/S$, where S_1 = area of one pair of the "Messenger" wings, and S = the area of our wings, M_1 the quantity FK on the "Messenger," and M the same quantity for our machine. From the foregoing $78.34/M = 76/60$, or $M = 61.8$.

The foregoing means that our ailerons must be so shaped and placed that their area multiplied by the distance from their center to the longitudinal axis of the airplane will equal 61.8. For purposes of contrast let us assume that we have decided to place our ailerons on the lower wing only and make their span equal to the length of the wing. At once we see that the distance from their center to the longitudinal axis of the machine will be ½ the length of one wing. This distance is seen to be $17.5/2/2 = 4.37$ ft. M for our machine being 61.8, gives us an aileron area of 61.8/4.37, or 14.15 sq. ft. Assuming that our fuselage is 2½ ft. wide, our lower wing or aileron length will be 17.5/2 minus 1.25, or 7.50 ft. The chord will thus have to be 14.15/7.5, or 1.885 ft. This value is seen at once to be excessive, which will require that we adjust our ailerons to both upper and lower wings, which is an easy matter now that we know $M = 61.8$.

Assume a distance X from the longitudinal axis and an aileron area of A, we see that using two ailerons $2A \times X = 61.8$. We know that X will be somewhere around ⅔ of half the machine's span, so assuming it to be 6 ft. we see that A will have to be $61.8/X/2 = 5.12$ sq. ft. The length of the aileron is from the foregoing $(8.75 - 6) \times 2 = 5.5$ ft. which makes the aileron chord 5.12/5.5, or 0.931 ft.

Characteristics of the Airplane

From our calculations so far, which we must not take as final, but simply as trial or approximate figures, we see that the characteristics of our airplane are roughly:

Span, 17.5 ft.
Chord, 3.5 ft.
C.g. to stern post, 9.5 ft.
Total area, 120 sq. ft.
Aileron dimensions 5.5 × 0.931 ft.
Area stabilizer, 8.18 sq. ft.
Area elevators, 7.91 sq. ft.
Area rudder, 4.53 sq. ft.
Area fin, 2.17 sq. ft.
Area ailerons, 4 × 5.12 = 20.48 sq. ft. (Total)

The First Sketch

Many of the approximate characteristics having now been determined, we can proceed, after a few minor considerations, to our first outline sketch which will give us an idea of the proportions which our airplane would assume. The distance between the upper and lower wings, or the gap, will necessarily have to be determined at once. The gap-chord ratio should be as large as possible and a positive stagger as large as can reasonably be used also adds to the performance characteristics of the machine. Taking the foregoing into consideration and examining once more the "Messenger," we find that the gap chord ratio is 46/48 (expressed in inches) or 0.96. Using this as a guide we see that our gap will be around 34 in.

Knowing, now, the characteristics of the wings, the tail surfaces and other distances from the center of gravity of the airplane, which we can assume to be near the center of pressure of the wings, we can make a rough sketch of our airplane. The center of pressure when the machine is in normal horizontal flight, will be around 35 per cent of the chord to the rear of the leading edge of the wings. This center of pressure should with proper design be made to coincide as nearly as possible with the longitudinal location of the center of gravity.

The outlines of the various control surfaces should be laid out on the preliminary sketch with a view toward regularity, balance, and strength of the interior supporting framework. A prominent designer has said that the design of an airplane is as much an art as a science. In the foregoing at least will be found an opportunity to put this into practice.

Next in our consideration will come the question of weights. Our total weight has been assumed to be about 600 lb. Allowing the operator a maximum weight of 180 lb. we see that the total weight of our airplane empty ready to fly cannot exceed 420 lb. Of the empty weight, 125 lb. is taken up by the engine, leaving 295 lb. for the weight of the structure itself, including gasoline, oil, and tanks. For purposes of arriving at a weight distribution we will assume that the fuel and its containers will weigh 40 lb. Subtracting the latter we still have an allowance of 255 lb. Our wing truss, taking the "Messenger" as an example, which weighs 1.1 lb. per sq. ft., will weigh 132 lb. which leaves us a total of 123 lb. for our fuselage, landing gear, tail surfaces, instruments and control mechanism. Taking the weights of these parts as about 23 per cent of the total weight of the airplane would give us a required weight of 138 lb. This shows that our assumptions are near enough actual practice that we can rearrange satisfactorily in our final computations.

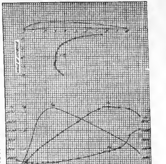
A second preliminary drawing can now be made inasmuch as we have made a temporary distribution of our weights which will now allow us to locate the engine, gasoline and oil tanks, pilot's seat, etc.

There now remains the location of the landing gear. In the first place, the height of the landing gear will be of necessity such as will allow the propeller to clear the ground at a reasonable distance when the airplane is in flying position. The location of the axle of the wheels relative to the center of gravity should be such that the airplane will not tend to "nose over" when landing, taking off or taxiing. The exact point where this axle is located will of course be determined by the center of gravity of the airplane, which will naturally fall some distance to the rear of the axle.

In the preliminary sketches of the machine, the matter of visibility should not be overlooked. The pilot's seat should be so placed that he will be able to see as much in every direction as is possible. In other words, every attempt should be made to make the blind angle as small as possible. The location of the upper and lower wings relative to the pilot's seat will naturally effect the visibility of the machine more than any other feature and for this reason great care should be taken when these parts of the structure are located.

Performance

With the characteristics of our airplane determined, for the time being, we now must interest ourselves in its expected performance. With these considerations will naturally come information that will cause us to change certain of the characteristics in order to secure certain desired performance.



Characteristics of aerofoil USA5

It is at this point that "juggling" of all the foregoing must occur before we arrive at definite figures. The flying qualities and charactertistics of an airplane depend to a very large extent upon the airfoil or wing section employed, the attitude at which this airfoil is set, the engine power available and the total supporting area of the wings. For a moment in the following we will consider the probable minimum flying speeds at which we can hope to, with a total supporting surface of 120 sq. ft. and using the same airfoil that is used on the "Messenger" (U.S.A. Section No. 5), maintain flight.

From the airfoil characteristics of the U.S.A. 5 Section, as shown in the accompanying figure, it is seen that our maximum lift coefficient (K_y) will be 0.003235 lb. per sq. ft. per mile per hour. For the formula ($L = K_y A V^2$) we get our total lift, where L = total lift; K_y = lift coefficient; A = area in sq. ft.; V = speed in miles per hour. We see that if we put L = 600 lb. (our total weight) and solve the equation $600 = 0.003235 \times 120 \times V^2$ our lowest speed will be 39 m.p.h. This value is fairly high but can be reduced with added area of wing surfaces and a higher lift wing section. For the time being as we are primarily interested in whether or not our machine will fly, we will neglect its high speed considerations and examine into whether or not our 30 hp. available will be sufficient to take it off the ground.

The resistance to forward motion that will have to be overcome by our engine at the moment when our speed equals 39 m.p.h. and our lift equals 600 lb. will consist of the drag of the wings plus the structural or parasite resistance of the remaining parts of the machine.

The resistance due to our wings (see airfoil data) will be 600/8.28 or 72.5 lb. Assuming that for our machine the parasite resistance is equal to $0.045V^2$ lb. where V is in miles per hour, it will be $0.045 \times 39^2 = 68.45$ lb. Our total resistance is then 68.45 plus 72.5, or 140.95, or about 141 lb.

In order to move 141 lb. at the rate of 39 m.p.h. we need

TABLE OF CHARACTERISTICS OF THE WORLD'S SMALL AIRPLANES

Ref No	Name	Nationality	Type	Overall Dimensions: Length	Height	Width	Engines: No. Seats	No.	Make	hp	Wings and Control Surfaces: Incidence Upper	Incidence Lower	Chord Upper	Chord Lower	Span Upper	Span Lower	Areas in sq ft: Total	Ailerons	Stabilizer	Elevators	Vertical fin	Rudder	Setting: Gap	Stagger	Dihedral	Weights in pounds: Empty	Gas, oil	Useful	Gross	Lb./hp	Lb./sq ft	Speed m.p.h.: High	Landing
(1)	Ace	Amer	T.B. Land	18'1"		28'6"	1	1	Ace	40			4'0"	4'6"	23'6"											600		230	863	20.0		60	60
(2)	Austin "Whippet"	British	T.B. Land	16'	7'8"	22'0"	1	1	Anzani	45	1°		3'1½"				144		11.0	11	0.47	4.70	3'0"	8¾"	3°	580		260	810	18	5.60	95	35
(3)	Avro "543"	British	T.B. Land	17'3"		28'	1	1	Green	35	3½°	3½°	4'	4'	28'	20'	180	27	3.5	6.6	None	3.0	4'	10"	3°	607½		237	844	24.1	4.69	70	40
(4)	Avro "534" (Baby)	British	T.B. Land	20	7'8"	26'	1	1	Green	40	4½°	4½°	4'	4'	25'	23'	178	21	14.5	7.9	None	7.0	4'3"	19"	3°	650	73	240	870	24.3	5.8	80	40
(5)	RAE "Crow" (FE30)	British	T.M. Land	14'	5'9"	18'	1	1	ABC Gnat	40					18'		73									285		285	400	11.0	6.15	65	60
(6)	Beardmore (WBV1C)	British	T.B. Land	15'7"	5'10"	21'	1	1	ABC	40							125.9									447		330	770	19.3	6.13	85	47
	Blackburn "Sidecar"	British	T.M.	20'9"	4'8"	27'6"	2	1	ABC Gnat	40							120													15.3		85	40
(7)	Bristol "Babe"	British	T.B. Land	14'11"	4'9"	19'9"	1	1	ABC Gadfly / Siddeley	45 / 40			3'11⅛"	3'9"	19'6"	19'3"	134.8	19.5	9	4.8	2.10	4.1	3'7" / 3'9"			460	35	230	683	17.1	5.5	80	40
(8)	Dayton-Wright (T4) "Messenger"	Amer	T.B. Land	17'9"	6'1"	19'3"	1	1	Wright	37	2°	2°	3'9"	3'9"	19'3"	19'0"	117	09	7.5	8		3.0	in 3'3"	6"	U-0° L-3°	470	70	215	725	19.8	6.1	81	40
	Didier "Oiseau Bleu"	French	2P.M.	4'6"		18'6"	1	2	3 hp. each	4																							
	Farman "Moustique"	French	T.M.			11'	1	1	ABC	30							93.7									220			485	24.3	8	40	
(9)	Farman "David"	French	T.B. Land	18'3"		31'11"	1	1	Le Rhone	40			4'10"		31'11"		219															95	57
(10)	Fetters "Kite"	Amer	T.B. Land	18'10"		18'	1	1	Anzani	30			3'		34'	26'							3'8"	6"		335		310	540	18.0		60	35
	Fokker	Dutch	T.M.	19'1½"		14'6"	1	1	Inverted "T"	30																						75	
(11)	Gabardini "Monoplane"	Italian	T.M. Land			22'9"	1	1	Anzani	35							104															62	
(12)	Gallaudet "Chummy Flyabout"	Amer	2 P.M. Land	18'7"	8'	23'	2	2	Indian Motor-cycle 10 hp.	10			4'6"		29'		195		10	9	8	4			1°	600	55	230	850	22.9	3.3	40	40
(13)	Gosport "Shrimp"	British	P.B. Sea	19'	17'6"	26'	1	1	ABC	40			4'6" / 5'	3' / 4'3"	29'	17'3"	140						3'6"		U-0°	440	72	270	750	18.7	5.35	60	35
(14)	Hild & Marshonet	Amer	T.B. Land	16'	7'	24'	1	1	Hild & Marshonet	35	4°	4°	to 5'	to 3'	24'		160	18	8	21	3	8			L-0°	350		250	700	16.	4.37	95	55
	Jennings "RC Junior"	Amer	T.B. Land	19'3"	8'	26'	1	1	Jennings	35			4'		29'		204						4'3"	6"		340		240	560	16.0	2.82	74	32
	Jennings "Sportplane"	Amer	T.B. Land	20'11"	9'2"	32'	1	1	Jennings	35	4½°	4½°	4'		29'		208	40	09	5.8		8.8	4'3"	6"	3°	350						40	37
(15)	Louis Clement "Triplane"	French	T.T. Land	19'2"		16'½"	1	1	Anzani 3 Cyl.	35							142									381		230	601	18.25	2.88		
(16)	Loughead "S1"	Amer	T.M. Land	21'	7'6"	28'	1	1	Loughead	25					29'	24'										378		225	330	24		70	35
(17)	Macchi "M16"	Italian	T.B. Land / Sea	18'9"		14'6"	1	1	ABC Gnat / Anzani	40 / 30							120									333	60	230	570	14.35 / 16.10	4.40	80	35
(18)	Marcay "Passepartout"	French	T.B. Land	12'5½"	4'8"	16'5"	1	1	ABC	20							80.7									270 / 400		205 / 375	365 / 775	18.25 / 22.2	4.70 / 7.17	60 / 85	35
(19)	Maryland "Bellanca"	Amer	T.B. Land	17'7"		30'	1	1	Anzani	35			4'	3'6"	30'	30'6"	180																
(20)	Martin "K3"	Amer	T.B. Land	13'9"	7'9"	17'11"	1	1	ABC Gnat 2 CYC	40			3'6"	4'3"	17'11"	15'	101	10	9.5	8	7	4.0	4'8"			350	52	230	570	14.25	5.65	105	
(21)	Mummert "Cootie"	Amer	T.M. Land	15'		16'	1	1	Lawrence	20			32"		16'		60						35"			330		150	500	24	4.97	100	45
(22)	Nieuport "2N"	French	T.M. Land	19'0"		24'3"	1	1	Nieuport Thulin	30							160									520		252	691	21.4	5.09	35	
(23)	Paalen	Sweden	T.T. Land	19'0"	7'8½"	28'0"	1	1	(Like Rhone)	40																715		387	1102	22		51	
(24)	Pensuti "Caproni"	Italian	T.T. Land	12'5⅛"	7'10⅛"	13'1"	1	1	Anzani	35																			607	16.40		60	35

Ref No	Name	Nationality	Type	Length	Height	Width	No. Seats	No.	Make	hp	Chord Upper	Chord Lower	Span Upper	Span Lower	Total	Ailerons	Stabilizer	Elevators	Vertical fin	Rudder	Gap	Stagger	Dihedral	Empty	Gas, oil	Useful	Gross	Lb./hp	Lb./sq ft	High	Landing
(25)	Pensuti "Breda"	Italian	T.T. Land	14'6"	9'6"	13'1"	1	1	Anzani	40														400			640	14.25		81	57
(26)	Pischoff "Avionette"	French	T.B. Land	11'7"	4'8"	17'	1	1	Clerget	18			17'		81									280						60	
(27)	Pischoff "Estafette"	French	T.B. Land	13.1'	3.2'	18'	1	1	Anzani	20-30 / 35					108									358		242	838	28.7	5.8	71	42
(28)	Pierce	Amer	T.B. Land	20		38		1	Pierce	40	4'		36'	20'	184						5'8"	1'		686							
(29)	Potez "SEA8"	French	T.B. Land	16'5½"	8'8½"	28'3"	2	1	Potez	38	4'8"		26.3'	22'4"	208	13	8	15	8	8	7	4.85	4.82	485	88	440	925	18.5	4.48		
(30)	PV7 "Grain Kitten"	British	T.B. Land	14'11"	5'9"	18'	1	1	ABC Gnat	35	3'6"	2'6"	18'	12'7"	83						5'			278	40	220	498	14.13	5.62	88	40
(31)	PV8 "East Church Kitten"	British	T.B. Land	18'7"	5'6"	18'	1	1	ABC Gnat	35	3'	3'	18'	18'	108						5'			340	60	248	588	16.78	5.52	88	45
(32)	Raymond Carroll	Amer	T.B. T.T.	18		26'	1	1	Excelsior Motorcycle	18														235							
(33)	Ricci "R6"	Italian	T.T. Land	12'4"	7'2½"	11'6"	1	1	Anzani	40			11'6"		118									330		242	572	14.3	4.85	78	35
(34)	Riessler "Sport"	German	T.M. T Mul	18'		28'	1	1	Haacke Viertakt	30					118									292	44		310	17	4.88		28
(35)	Sanchez-Besa Multiplane	French	T.M. Land	16.4'	10.65'	14.78'	1	1	ABC	40	5"	3"			188									464 / 407		330	687	21.4		78	67
(36)	Sablatnig "KE1"	German	T.B. Land	17'5"	7'3"	27'6"	1	1	Rheinische	20			27'6"																		
	Spad "330"	French	T.M.	18'6"	7'4"	28'5"	1	1	Anzani	40			28'8"		128									573		400	888	19.8		87	57
(37)	White "Sportplane"	Amer	T.B. Land	14'		23'	1	1	Indian or Harley D Motorcycle	18			28'									3'1" to		200		130	330	33		30	
(38)	WEF "Kleinflugzeug"	Austrian	Land	14'3"	7'	17'3"	1	1	Haacke	35	3'3"	3'3"	17'8"	17'3"	161	8	8	4	8	8 2	8 5	5'4"	21"	564		383	747	21.4	7.4	81	

NOTES T.B.—Tractor Biplane P.B.—Pusher Biplane T.M.—Tractor Monoplane P.M.—Pusher Monoplane Sea—Seaplane
T.T.—Tractor Triplane T.Mult.—Tractor Multiplane 2 P.M.—Twin Pusher Monoplane Land—Landplane

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(2) Janes 1919 Pg 89 a Aeronautics 1/1/20-7/8/20 Flugsport March 1920 Aeroplane 7/14/20-Janes 1920
(3) Flight June 26 1919 Aeroplane 12/12/19 5/28/19-4/30/19
(4) Janes 1920 Pg 66 a—Flight 11/4/20
(5) Janes 1919 Pg 77 a
(6) Janes 1919 Pg 75 a Flight 7/15/20 Aeroplane 12/24/19 Janes 1920 Pg 99 a Aircraft Journal 9/27/19
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(31) Aeroplane 11/12/19
(32) Aerial Age 11/18/19
(33) Janes 1920 Pg 250 a Aeroplane 1/29/20
(34) Luftfahrt Aug 1921
(35) L'Air 11/5/21 L'Air Jan 1922
(36) Aeroplane 6/23/20
(37) Aerial Age Sept 25 1919
(38) Aeroplane 9/1/20 Janes 1920 Pg 14 a

$141 \times 39 \times 5280/60/33000$, or 14.7 hp. which comes well within our available limits (about 87 per cent of 30 hp.).

Conclusion

While the calculations preceding are given in order to show a method by which preliminary characteristics of an airplane may be determined, it is easily seen that before final figures are determined upon much juggling of characteristics will be required. For example, an airfoil could be selected which would give a greater unit lift, which would in turn reduce the landing or minimum speed of the airplane. On the other hand, increased supporting surfaces would assist in lowering the minimum speed of the machine. An increase, on the other hand, of weight, would have the opposite effect, etc.

For purposes of checking up the final design, it is suggested that in addition to a review of existing types, which may be made from the chart which I have prepared, the following limits which are considered good practice should be carefully compared with the characteristics determined upon for the machine being built. From various sources complete characteristics of several hundred airfoils are obtainable. However, a large number of these are in no way applicable to a sport type machine of the kind being considered, and are therefore not included in the airfoils suggested as worthy of examination in the following:

Aspect Ratio—The aspect ratio should be as great as is consistent with other structural requirements. A low limit of 3.75 and a maximum limit of 5 are suggested.

Gap/Chord Ratio—The gap/chord ratio should be kept as high as possible, with a minimum limit of around 0.75.

Airfoils—Wing sections recommended for consideration in such a design are U.S.A. 27, U.S.A. 5, or any other high lift section which does not have such an extreme spar depth as to cause difficulty in its application to a light machine.

Strut Placing—For a single bay biplane without center span the following interplane strut locations are suggested

Hinged at Center—Cantilever 36½%—Bay 63½%
Continuous at Center—Cantilever 32½%—Bay 67%

Spar Placing—The spars should be so spaced along the wing chord that in normal flying position the load will be distributed as nearly as possible equally between the spars. These positions are determined by the center of pressure travel of the particular airfoil used.

Weight Distribution—While it is difficult to place a limit on the weights of parts of airplanes due to the wide variation in different types, the following values may be used as a guide. These figures were made up from analysis of several very successful types. Percentages of total weights are shown:

Power plant exclusive of fuel tanks	= 32.3%
Fuel (gasoline & oil)	= 12.3%
Crew and personal equipment	= 17.45%
Fuselage complete and contents except preceding	= 17.78%
Weight of wings and truss members	= 14.1%
Landing gear	= 4.16%
Tail units and bracing	= 1.86%

Landing Gear Design—First the landing gear must be so designed that when taxiing the airscrew will have proper ground clearance. A minimum limit for this clearance may be set at 10 in.

Location of the wheels may be made by considering the following: longitudinally, the angle between the vertical through the point of tangency of the wheel to the ground and a line from this point through the center of gravity may vary between the limits of 15 to 18 deg.; vertically, the angle between the ground line and a line through the tip of the tail skid and the point of tangency of wheel to the ground may vary between 13 and 14 deg.

The ratio of tread to wing span should be somewhere around 0.17 to 0.21. All measurements are assumed to be made when the airplane is in "flying position."

Long Flight

Walter Beach, chief pilot for the E. M. Laird Co., Wichita, Kan., recently completed a remarkable trip covering 2,229 miles by air in 32 hr. Straight flying from Wichita to Detroit, which was one of Beach's objectives, by way of Chicago and return is 1,718 miles. Side trips were made to Mt. Clemens, Toledo, Minneapolis, Fort Dodge, Red Oak, Forest Park and other towns.

Aero Exhibition at Gothenburg, Sweden

We have received requests from officials of the Gothenburg exhibition for co-operation in securing representation of aerial products from the United States.

The exhibition will open at 12 o'clock noon on Friday, July 20 and close on Sunday, Aug. 12. The exhibition grounds will be open from 10 a. m. to 8 p. m. daily and all articles exhibited must remain on view during these hours. The exhibition will be held on the open space known as Exercisheden, which has an area of 120,000 sq. meters and, in addition to a number of smaller buildings, a large exhibition hall will be erected with a floor space of 9,650 sq. meters.

Definite applications for space must be in the hands of the board on or before Jan. 1, 1923. Applications must be made upon a prescribed form, in accordance with the regulations issued by the board and shall contain a full description of the proposed exhibit, and no alteration shall be made in respect of the object or objects exhibited without the permission of the board. The board reserves to itself the right to refuse any application. Copies of the program may be obtained from the Aeronautical Chamber of America. For detailed information communicate with Thorsten Gerle, Director General of Posts, Stockholm, Sweden.

Model 1923 Farman Sport

The 1923 Model Farman 2-seater touring and sport plane, which is shown on this page, is equipped with the new 50-60 hp. 6 cylinder Anzani air-cooled motor. The new model also contains minor improvements calculated to increase the performance of the little machine which has in the past been considered highly efficient.

Wallace Kellett Co., Inc., Philadelphia, have also announced a reduction in price for the 1923 models.

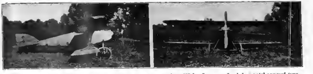
Change of Address

The New York office of Underwriters' Laboratories on Dec. 1 was removed from 25 City Hall Place to the Underwriters' Laboratories' Building, 109-111 Leonard St., between Broadway and Lafayette Streets, and opposite the New York Life Insurance Building.

Farman 2-seater touring and sport airplane, 1923 model, fitted with the new 50-60 hp. Anzani radial engine. Note the long exhaust pipe for silencing the engine exhaust

Swanson Model 3 Sport Plane

Small Single-Seater Fitted with Lawrance Engine Has Good Performance



Side and front views of the Swanson model 3 single-seater sport plane (28 hp. Lawrance 2 cyl. horizontal opposed type engine)

The Swanson SSS model 3 single seater sport plane was designed and constructed by S. Swanson of Vermillion, S. Dak. The ship was given its first test flights Sept. 24, 1922.

The test pilot, Lieut. Vert Roggers of Yankton, S. Dak. took the little machine off, after a short run over a rough field where alfalfa stood ten inches high, circled the field once and made a perfect landing. He immediately took off again and climbed to a height of 1000 ft., then circled over Vermillion for 15 min. and landed with the same ease with which he lands higher powered machines. He states that the plane is well balanced and light on the controls, answering promptly to the various maneuvers.

The general construction of the plane is as follows.

Wings

The webs of the ribs are Bass wood with the usual lightening holes, cap strips are of spruce. Spars are of the routed I beam section also of spruce and spliced in the center so that they are continuous spars through the whole span of the wing with a dihedral of 4 deg., both planes are built in one continuous panel from tip to tip.

The upper plane has a cut-away at the center over the cockpit and is fastened to the center N struts with four bolts. The lower plane, which is a single panel, is fastened to the underside of fuselage with three bolts. The ailerons are on lower plane only, and aileron control wires run within the lower wing.

The single I struts on each side of interplane bracing are of built-up spruce laminations. Landing wires are single flying wires are double, all are 3/32 in. cable.

Fuselage

The fuselage is of the girder type built of spruce, the longerons being of ash forward of cockpit. The cockpit has plenty of leg room for such a small machine. The rear end of fuselage tapers off into a horizontal wedge, the whole being nicely streamlined with basswood false work. The cowling is of 20 ga. aluminum. A three hour duration gas tank is located between the fuselage and cowling just over the center of gravity. The engine is separated from the fuselage by an aluminum wall.

Tailplane

The fixed horizontal tailplane is built into the fuselage and has one-third of its camber on the lower surface and two-thirds on the upper surface, the elevators have a negative rake of 20 deg. The tailbeam to which are hinged the elevators, is a continuous beam of 8 ft. span, which is also the stern post of fuselage and has no external bracing. The rudder fin is also built into the fuselage and projects through on lower side so that there is a small vertical fin disposed on the under side, to which is attached the tailskid. This is of ash, sprung by rubber shock absorber cord. All control flaps have a special hinge construction which leaves no gap between surfaces, namely, a round leading edge of the flaps which fit into a round groove in the fin side, thus ensuring a smooth and even flow of the air over the surfaces. All control surfaces are negatively raked, except the top edge of rudder. There is no external bracing on the tailplane whatever, all control horns being built into the various flaps.

Great simplicity in assembling is a feature of this ship.

Controls

Standard stick and foot bar controls are used and so arranged that large movements of the stick produce but small movements of the various flaps.

Landing Gear

The undercarriage is of the Vee type with a split axle hinged nine inches on each side of center, the struts are of streamlined section ash. Wheels are 24 in. x 2 in. sprung by the usual rubber shock absorbers, while the track is 4½ ft. wide.

Power Plant

An air-cooled 2 cyl. opposed Lawrance 28 hp. motor is used and is left uncovered where it is amply cooled. The carburetor is outside of the fuselage whereby the risk of fire is decreased.

The propeller has a pitch of 6½ ft. and a diameter of 5½ ft. which the engine turns at 1500 r.p.m.

Following is the general specification of the plane.

SPECIFICATIONS

Dimensions
Span both wings, 18 ft. 0 in.
Chord both wings, 24 in.
Gap between wings, 40 in.
Stagger, 14 in.
Length overall, 15 ft.
Height overall, 5 ft. 7 in.

Wings
Wing curve, U. S. A. 15
Total wing area, 100 sq. ft.
Angle of incidence top wing, 3½ deg.
Angle of incidence bottom wing, 2 deg.
Decalage, 1½ deg.
Dihedral both wings, 4 deg.

Tail Unit
Stabilizer area, 7 sq. ft.
Elevator area, 5 sq. ft.
Fin area, 8 sq. ft.
Rudder area, 3 sq. ft.
Aileron area each, 6 sq. ft.

Weights
Weight empty, 370 lb.
Weight loaded (full load), 570 lb.
Wing loading, 5.7 lb./sq. ft.
Power loading, 20 lb./hp.

Performance
Maximum speed, 80 m.p.h.
Minimum speed, 40 m.p.h.
Engine, Lawrance 2 cyl., 28 hp.
Propeller 5½ ft. dia. with 6½ ft. pitch.
Propeller speed, 1500 r.p.m.

Air Mail Notes

Even in the stormy month of November the Air Mail Service is able to set up efficiency marks. According to an official report the Air Mail Service had an efficiency record of 100 per cent on all three divisions of the trans-continental route for one week last month. This is an unusual accomplishment considering the inclemency of the weather during November, particularly over the mountain regions in the east and west. In Europe most of the air lines suspend during the winter months, but the Post Office Department air mail service runs the year round. The air service achieves this record despite the fact that its planes run into more severe weather than planes on European lines encounter.

Changes in the administration systems of the Air Mail Service started last week with the abolishing of the positions of superintendent of the bureau of communication and assistant general superintendent of air mail. These services will now be directly under Carl F. Egge, superintendent of air mail.

James C. Edgerton, chief of the bureau of communication, and Charles L. Stanton, assistant general superintendent of the air mail, have submitted their resignations to become effective Dec 31, 1922.

Lawrance Engine Runs 200 Hr. Test

Following the excellent showing made by the 200 hp. Lawrance model J radial air-cooled engine in the last Curtiss Marine Flying Trophy race, the winner of which was equipped with this power plant, it is interesting to hear that in a recent endurance test this engine ran for over 200 hr.

The exact figure was 201 hr., the last 36 hr. of which were a continuous run, no stops or adjustments of any kind being made. This last run is the longest on record for an air-cooled engine. The 201 hr. of running was accomplished without overhaul of any kind, without the change of any of the accessories, including magnetos, spark plugs and wiring. At the end of the run all bearings and bearing surfaces were in excellent condition, barely showing any sign of wear.

For the total run of 201 hr. the engine developed an average of 182 7 hp at approximately 1705 r p m with an average gasoline consumption of 0 501 lb. per hp hr, and an average oil consumption of 0 019 per hp hr.

A 300 hr. full throttle endurance test is shortly to be begun with a Lawrance J engine fitted with valves of a new type.

Roos-Bellanca Airplane Co.

A company to manufacture Bellanca airplanes from designs of Prof J M Bellanca has been organized under the name of Roos-Bellanca Airplane Co, Omaha, Neb.

Prof Bellanca is internationally known as an aeronautical engineer, airplane designer and constructor, whose activity in the field began in 1906.

Victor H. Roos, organizer of the company, is a prominent Omaha business man and is one of the largest dealers in motorcycles and bicycles in the middle west.

The first model to be produced will be the Bellanca CF monoplane which was described in detail in the Aug 14, 1922 issue of AVIATION. It is expected that production of this model will soon be under way and that it will be possible for the company to begin deliveries about June 1923.

Aerial Survey of Oil Fields

An unusual photographic feat was recently performed by the Army Air Service for the Bureau of Mines with the making of a mosaic map of the Salt Creek and Teapot oil fields in Wyoming. An area of 336 square miles was photographed by the Army ship. The pictures were taken from an elevation of 15,000 ft. above sea level on films 100 ft. in length. It required in the neighborhood of 450 pictures and 16 hr flying time to cover the area. Some of the richest oil bearing reserves in the public lands of the United States are included in this area. Technical supervision of the production of oil and gas on public lands is entrusted to the Bureau of Mines.

Contenders for Collier Trophy

Contenders for the Collier Trophy should present their claims in writing to the "Collier Trophy Committee, National Aeronautic Association, 26 Jackson Place, Washington, D C" before Monday, Jan. 1, 1923.

The Collier Trophy is of bronze, and was presented by the late Robert J. Collier. The trophy is to be awarded annually for the greatest achievement in aviation in America, the value of which has been thoroughly demonstrated by use during the preceding year.

The first award was given to Glenn H. Curtiss for his development and demonstration of the seaplane during the year 1911. The trophy for the year 1912 was again awarded to Mr. Curtiss for his development and thorough demonstration of the flying boat, in which buoyancy is supplied by the fuselage. In 1913 the trophy was awarded to Orville Wright in recognition of the development and demonstration of his automatic stabilizer. For 1914 the trophy was awarded to Elmer A Sperry, for his work in achieving the automatic control of an airplane by means of the gyroscope. The trophy for the year 1915 was awarded to W. Starling Burgess, of Marblehead, Mass., in recognition of his development and demonstration of the Burgess-Dunne seaplane. The trophy for 1916 was awarded to Elmer A Sperry for the development and thorough demonstration of the Sperry Drift Set. This trophy was not awarded during 1917 or 1919 on account of the War. In 1921 this trophy was awarded to Grover C. Loening, for the development and demonstration of his aerial yacht.

The Collier Trophy Committee consists of Dr. George W. Lewis, Chairman; Porter H Adams; Maurice J. Cleary; B Russell Shaw.

Gliding Flight Committee Appointed

In order to foster and encourage sailplaning in the United States, the National Aeronautic Association of U S A. has appointed a sub-committee to investigate and report on glider contests, suitable locations, and times of the year in which glider contests may be successfully conducted, and to furnish data to interested persons who desire to compete in such contests.

The Chairman of this committee is Orville Wright, who nineteen years ago made the first flight in a mechanically propelled "heavier-than-air" machine. Mr Wright will be assisted in his labors by the following members of the committee Dr. George W Lewis, Executive Secretary of the National Advisory Committee for Aeronautics; Prof. E. P Warner, in charge of Aeronautical Department at the Massachusetts Institute of Technology, E T Allen, of Massachusetts Institute of Technology, who took the M I T Glider abroad last summer in the French and German Glider Contests, and B Russell Shaw, executive vice-chairman of the Contest Committee of the National Aeronautic Association.

Mr. Wright himself has had much experience in gliding the successful design of the Wright Brothers' first airplane being largely due to data and experience gained from gliding. Mr Wright's record for hovering over one spot, has never been equalled, although more than twenty years have elapsed since the Kitty Hawk exhibition.

Personal Notes

C Roy Keys is now in charge of production at the Buffalo plant of the Curtiss Aeroplane & Motor Corp, while C E Gilmore is in charge of all engineering operations at the Garden City plant.

• • •

H Barber, F R Ae.S, Aeronautical Consultant and Underwriter, announces that Robert H Baldwin is now associated with him in business at 30 East 42nd Street, New York. Mr Baldwin has had some ten years experience in insurance and banking and, during the war, qualified as an artillery air observer and saw considerable active service in France.

ARMY AND NAVY AIR NEWS

Air Service

Definition of Flying Service—In connection with General Orders, No 30, War Department, 1922, the following Executive Order is published to the Army for the information and guidance of all concerned:

For the purpose of further carrying into effect the provisions of Section 20 of the Act of Congress, approved June 10, 1922, relative to increased pay for duty involving flying, and allowance for traveling expenses incident thereto, the Executive Order of July 1, 1922, is amended by adding the following:

(1) "Duty involving flying" is defined as any duty which requires participation in flights in aircraft as prescribed in Paragraph 9 of the Executive Order of July 1, 1922. The personnel of the Air Service of the Army and of the aeronautical organizations of the Navy, Marine Corps, and Coast Guard must be available at all times to render flying service. The rated personnel of these branches or services, and, subject to the limitations imposed by Section 20 of Act of June 10, 1922, such other personnel assigned or attached to these branches or services as the respective chiefs thereof designate for such duty, are and shall be, required to participate in flights as prescribed in said Paragraph 9 and this duty shall be duty involving flying and shall be performed in addition to any other duty or duties to which such personnel may be detailed. All of this personnel thus placed in duty involving flying shall participate in aerial flights as prescribed in said Paragraph 9, unless prevented from so doing by sickness or injury, or unless specifically relieved from the performance of such flying duty by the orders of competent authority.

(2) An "aerial flight" is defined as a journey in an aircraft and such aerial flight will begin when the aircraft leaves the ground or water and will terminate when again at rest on the ground or water.

(3) Compliance with Paragraph 9 of the Executive Order of July 1, 1922, shall constitute frequent and regular flights within the meaning of the Act of June 30, 1922, (Public 259), 67th Congress.

(4) Authorized leaves of absence of personnel detailed to duty involving flying shall not suspend such detail for pay purposes.

(5) "Travel by air" is defined as a journey in an aircraft made by orders of competent authority and which requires one or more landings away from the starting point.

(6) A "continuous journey by air" is defined as any journey performed in an aircraft under the orders of competent authority, from and return to the place of permanent station or to other final destination named in the orders, which requires one or more landings, provided that the stop, except that due to the causes set forth below, in any one locality does not exceed seventy-two hours.

(7) A "necessary delay" incident to one or more of the following conditions is a delay during a continuous voyage (a) Unfavorable weather conditions (b) Necessary repairs to aerial equipment.

• • •

Montgomery A.I.D Renamed "Maxwell Field"—Montgomery Air Intermediate Depot, Montgomery, Ala., has been officially renamed "Maxwell Field," in honor of 2nd Lieut William C Maxfield, A. S, a native of Alabama who died Aug 12, 1920, as the result of an airplane accident in the Philippine Islands while he was a member of the 3d Aero Squadrons.

• • •

Change in Status—The 28th Aero Squadron is being reorganized at Clark Field, P. I.

2nd Bombardment Group—The 2nd Bombardment Group, Langley Field, Va, was recently engaged in a series of tests with the Coast Artillery. The first problem was to erect a smoke screen on a number of small vessels representing an enemy fleet approaching Fort Monroe. Five planes of the Group representing enemy aircraft, easily located the fleet and at once put down a very effective screen between the fleet and the Fort. Although only twenty-four bombs were dropped, the splendid location of the screen carried the fleet hidden until past the forts.

On the first day of the test a flight of five Martins bombed a 10 x 10 ft pyramidal target towed, on 20 x 20 ft raft, from 3000 ft. The results of this test were reported editorially in the last issue of AVIATION.

On the second day the tests from 6000 ft. were about to begin when the target turned over and sunk before a bomb had been dropped. After flying around for two hours in the zero temperature, the formation gave up the possibility of getting another target out in time and returned home. During the period of waiting radio telephone communication was maintained with the fort the entire time and it was due to their "wait ten minutes more" that the planes remained.

On the third day the famous flight appeared over the target again at 6000 ft. and outdid themselves. Each of the five ships carried four 300 lb "duds" and the first two bombs lacked but a few feet of running the target. Not one bomb fell outside the effective zone. This demonstration is all the more remarkable when it is considered that at 6000 ft. was a layer of heavy clouds, which not only obscured the tiny target at times but bounced the ships around like the proverbial cork.

The last of this series of tests was made from 8000 ft. Although the weather was bitter and a layer of clouds, skimming along at 4000 ft., 80 per cent of the shots were classified as effective hits.

• • •

Army Orders—First Lieut. Benjamin R Morton, A.S., from O C A S to Procurement Division.

Maj Bert. M. Atkinson, A S, to proceed home and await retirement.

Maj Arthur R Christie, A S, relieved from temp duty in Mil Intel Div, to office, Chief of Staff.

The following named first lieutenants, Air Service, from stations indicated to France Field, C Z: Edgar T. Selzer, Kelly Field; Kellogg Sloan, McCook Field; Levi L. Beery, Langley Field; John M. Upston, Montgomery A.I.D.; Arthur G Watson, Pope Field.

Capt Raymond E O'Neill, A S, from Scott Field to O.C A S.

Coming Aeronautical Events

FOREIGN

1923	
Dec. 15-Jan. 2	— *8th International Aeronautic Exposition, Paris France.*
June	*International Aero Congress, London.*
July 20-Aug. 12	— *International Aero Exhibition, Gothenburg, Sweden.*

The Missing Plane from Rockwell Field—Reports from Rockwell Field dated Dec. 10 indicate that Colonel Marshall and Pilot Webber, who have been missing for several days, probably crossed the line into Mexico about 30 miles west of Nogales, Ariz. Troops from Huachucha and Nogales are now patrolling through the mountains west of both stations, Colonel Arnold reports. All local sheriffs have been notified to look out for the lost officers and are said to be searching their territories. Six planes from that station are searching and five planes are also out from Fort Bliss.

• • •

Wheeler Field, Hawaii—The airdrome at Schofield Barracks, Hawaii, is named "Wheeler Field" in honor of Major Sheldon H. Wheeler, who was killed in an airplane accident July 13, 1921, at Luke Field, Hawaii, of which field he was in command at the time of his death.

Naval Aviation

Strength of Aircraft Squadrons—According to a recent weekly operations report of Naval Aviation the Aircraft Squadrons attached to the Battle Fleet had the following number of planes in active commission.

Observation Plane Squadron 1—Five Vought and three DH4B

Observation Plane Squadron 2—Six DH4B (Six Vought VE7SF planes in commission for training.)

Fighting Plane Squadron 1—Three VE7SF, one VE7T, one VE7GF and one JN4H

Fighting Plane Squadron 2—Five JN4H

Torpedo and Bombing Plane Squadron 2—Six F5L and two N9. (Two F5L for replacement.)

The Aircraft Squadrons, Scouting Fleet, consist of Scouting Plane Squadron 1 (F5L planes), Torpedo and Bombing Plane Squadron 1 and Kite Balloon Squadron 1

• • •

Naval Orders—Lt. j.g. Raymond E. Farnsworth, det. U.S.S. Reno, to Nav. Air Sta. Pensacola, Fla.

Ens. Edgar L. Adams, det. U.S.S. Mullany; to Nav. Air Sta. Pensacola, Fla.

Ens. Horton I. Booker, det. U.S.S. Marcus; to Nav. Air Sta. Pensacola, Fla.

Ens. Kenneth E. Brimmer, det. U.S.S. Broome, to Nav. Air Sta. Pensacola, Fla.

Ens. Charles M. Huntington, det. U.S.S. Long, to Nav. Air Sta. Pensacola, Fla.

Ens. Frederick W. Roberts, det. U.S.S. Stoddert, to Nav. Air Sta. Pensacola, Fla.

Ens. Walton W. Smith, det. U.S.S. Kennedy, to Nav. Air Sta. Pensacola, Fla.

Ens. Carroll L. Tyler, det. U.S.S. Chandler; to Nav. Air Sta. Pensacola, Fla.

Lt. j.g. Giles E. Short, det. Nav. Air Sta. Anacostia, D. C., to Aircraft Sqds. Scouting Fleet.

Ens. Robert F. Erdman, det. rec. ship New York; to Nav. Air Sta. Pensacola, Fla.

Ens. Earle C. Peterson, det. Nav. Air Sta. Pensacola, Fla., to wait orders.

Lieut. j.g. Russell V. Pollard, det. Kite Balloon Sqd. 1, to Nav. Air Sta. Hampton Roads, Va.

Lieut. Thomas E. Hipp (S.C.), det. Destroyers Sqds, Pacific Fleet, to Naval Aircraft Factory, Philadelphia

Ens. Warle B. Bark, det. Kite Balloon Sqd. 1, to Nav. Air Sta. Hampton Roads, Va.

Lieut. Herman E. Halland, det. Aircraft Sqds. Battle Fleet, to Nav. Air Sta. Pensacola, Fla.

Lieut. George R. Fairlamb, jr., to Nav. Air Sta. Pensacola, Fla.

Lieut. George W. Davis (S.C.), det. Nav. Aircraft Factory, Philadelphia, to Aircraft Sqds. Battle Fleet.

Lieut. Hugh St. C. Sease, to Nav. Air Sta. Pensacola, Fla.

Lieut. Guy D. Townsend, det. Nav. Air Sta. Hampton Roads, Va.; to Aircraft Sqds. Scouting Fleet.

Lt. Comdr. Harold W. Boynton, det. U.S. Bridgeport; to Nav. Air Sta. Hampton Roads, Va.

Ens. Charles L. Allen, det. Nav. Air Sta. Pensacola, Fla.; to wait orders.

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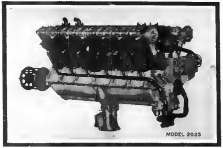

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